

24-1-21/26

On certain relations governing the dependence of the micro-hardness of the solid solution crystals on the composition of the alloy in a three-component system.

of the micro-hardness on the composition of the solid solution in the ternary systems Al-Mg-Si, Al-Cu-Mg and Cu-Zn-Sn were investigated on cuts for which the weight ratio between the alloying components equalled 1:1. Furthermore, the dependence was investigated of the micro-hardness on the composition on changing over from a single-phase to a two-phase diagram along connodal cuts and deviations to the right and left from the connodal cuts for the systems Al-Mg-Si and Cu-Zn-Sn. The location of these cuts and the composition of the investigated alloys are given on the isothermal cuts for 550°C for the system Al-Mg-Si (Fig. 2) and for 500°C for the system Cu-Zn-Sn (Fig. 3). The alloys were produced in graphite crucibles and cast into iron ingot moulds. The cast specimens were deformed on the average by 20% and then annealed for 75 hours; the system Al-Mg-Si was annealed at 550°C, whilst the system Cu-Zn-Sn and Al-Cu-Mg was annealed at 500°C. The micro-hardness was measured for loads of 10 to 20 g. The dependence of the micro-hardness on the composition for

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24-1-21/86

On certain relations governing the dependence of the micro-hardness of the solid solution crystals on the composition of the alloy in a three-component system.

a solid solution of the systems Al-Mg, Al-Si and Al-Mg-Si is graphed in Fig.4, the same dependence for the systems Cu-Zn, Cu-Sn and Cu-Zn-Sn is graphed in Fig.5, the same dependence for the systems Al-Mg, Al-Cu and Al-Cu-Mg is graphed in Fig.6. Experimental and calculated isotherms of the micro-hardness for the cuts I, II, III in the systems Al-Mg-Si and Cu-Zn-Sn are graphed in Figs. 8 and 9. On the basis of the obtained data, it can be assumed that the micro-hardness of solutions during alloying increases with increasing distortions of the lattice, primarily distortions of the third type. This conclusion requires experimental verification and represents a separate subject of investigation.

Card 4/4

There are 9 figures and 9 references - 8 Russian, 1 English.

SUBMITTED: May 4, 1957.

AVAILABLE: Library of Congress.

Glazov, V. M.

AUTHORS: Glazov, V. M. and Petrov, D.A. (Moscow). 30-3-5/23

TITLE: Investigation of the temperature dependence of the viscosity of germanium. (Issledovanie temperaturnoy zavisimosti vyazkosti germaniya).

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, No.2, pp. 15-19 (USSR).

ABSTRACT: This paper is devoted to investigating the temperature dependence of the viscosity of molten germanium during heating and cooling. As far as the authors are aware, this problem has not hitherto been studied. The experiments were made using a viscosimeter, a sketch of which is shown in Fig.1, p.16. The technique of investigation by means of this instrument was described in earlier work of the authors of this paper (Ref.1). The viscosity was determined at a vacuum of  $10^{-3}$  to  $10^{-4}$  mm Hg using a pure germanium with a specified resistance of about 55 Ohm.cm which was placed into a quartz cylinder preliminarily annealed at  $1000^{\circ}\text{C}$  for obtaining a constant weight. The diameter of the quartz cylinder equalled 1.1 cm; the weight of the germanium specimen was 13.35 g and the ratio of the height of filling up of the cylinder with germanium to the cylinder radius was 4.5. The

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11-1-3/100

Investigation of the temperature dependence of the viscosity of germanium.

temperature was measured by means of a thermocouple introduced into the melt and, additionally, the temperature in the furnace was measured. The viscosity was determined in the temperature range 140 to 110°C during heating, as well as during cooling, heating and cooling. The temperature was maintained for thirty minutes. The temperature dependence was determined five times in a "forward" series of measurements the cooling curve of the germanium was plotted. For each temperature the average was taken of five measurements of the logarithmic damping decrement of the oscillations of the cylinder which was filled with molten germanium. The suspension system was so designed that the kinematic viscosity could be measured in accordance with the formula applicable to low viscosity liquids. The dependence of the logarithmic damping decrement on the temperature is given in Fig. 1. On the basis of the measured values, the kinematic viscosity was calculated and the results of this calculation are graphed in Fig. 2. Utilizing density data obtained by Mokrovskiy, V.P. and Repel', A.I. (Ref. 3) the dynamic viscosity of germanium at various temperatures was

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Investigation of the temperature dependence of the viscosity of germanium. 74-2-1/25

calculated and the results are plotted in Fig. 4. In Fig. 5 the temperature dependence of the viscosity is graphed in semi-logarithmical coordinates and it can be seen that this dependence can be described by the known equation:

$$\ln \eta = A + B/T \quad (1)$$

The dependence of the fluidity of germanium on the density is graphed in Fig. 6 and the dependence of the free activation energy of the viscous flow on the temperature is graphed in Fig. 7. During the pre-crystallisation period a reconstruction of the short range order structure takes place in liquid germanium in a way similar to that taking place in water. This is attributed to the reconstruction of the short range order structure of liquid germanium to as much more closely the structure which is characteristic for solid germanium. It is likely that similar conclusions can be made also for silicon and other semi-conductors

Card 3/4 which are similar to germanium as regards the structure

Investigation of the temperature dependence of the viscosity of  
germanium.

and the character of their bonds.

There are 7 figures and 6 references - 4 in German.

1 German and 1 English.

SUBMITTED: October 21, 1957.

AVAILABLE: Library of Congress.

Card 4/4

VIGDOROVICH, V.N.; GLAZOV, V.M.

Additivity in increasing the microhardness of metal system solid solutions. *Izv.vys. ucheb. zav.; tsvet. met.* no.3:122-126 ' 58.  
(MIRA 11:11)

1. Moskovskiy institut tsvetnykh metallov i zolota, Institut metal-  
lurgii AN SSSR.  
(Solutions, Solid) (Alloys--Hardening)

SOV/24-58-4-25/59

AUTHORS: Glazov, V.M. and Petrov, D.A. (Moscow)

TITLE: Thermal Stability of the Antimonides of Aluminium, Gallium and Indium in Liquid State (O termicheskoy ustoychivosti antimonidov alyuminiya, galliya i indiya v zhidkom sostoyanii)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 4, pp 125 - 129 (USSR)

ABSTRACT: AlSb, GaSb and InSb have excellent semiconducting properties and can be used in a variety of instruments. Knowledge concerning their thermal stability is therefore valuable for determining the optimum conditions of their synthesis, of the production of their single crystals, of their purification by zonal recrystallisation, etc. In view of the lack of agreement in the data available in the literature, the present investigation was undertaken to determine the liquidus parts of the phase diagrams of the systems Al-Sb, Ga-Sb and In-Sb for a range of compositions around those corresponding to the compounds AlSb, GaSb and InSb and to study the thermal stability of these compounds.

Card1/4 The liquidus temperatures were determined from the



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# Thermal Stability of the Antimonides of Aluminium, Gallium and Indium in Liquid State

cooling curves (Figure 1) obtained with a differential pyrometer. A standard of reference was provided by pure silicon and the instrument was calibrated by reference to melting points of zinc, aluminium and silver. 7 alloys in each system were investigated, containing between 40 and 60% Sb. The liquidus of each system (Figure 2) was found to consist of two straight lines sloping upwards towards the middle of the diagram and intersecting at the point of the composition of the compound (AlSb, GaSb or InSb).

The thermal stability of the compounds, AlSb, GaSb and InSb, was investigated by determining and analysing the curves of kinematic viscosity vs. temperature. The curves (Figures 3-5) were obtained by means of a viscometer described in an earlier paper (Ref 11). In discussing the results, it is stated that the presence of a single, sharp maximum on the liquidus curves indicates that there is no dissociation of AlSb, GaSb and InSb at their melting points. On the other hand, the curves of kinematic viscosity, checked repeatedly, invariably show

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001/24-18-4-25/39

Thermal Stability of the Antimonides of Aluminium, Gallium and Indium in Liquid State

a divergence from the normal shape of such curves. This divergence is first observed at a temperature of some 150 °C above the melting point and gradually increases at higher temperatures. Although no data are given, it is said that the same characteristic is displayed by the curves of dynamic viscosity and the curves of attenuation of oscillations of cylinders filled with the molten compounds. No such divergences of the viscosity curves were observed by the authors in their earlier investigation of germanium and it is concluded that in the present case they can only indicate the beginning of a dissociation of the compounds at higher temperatures.

Further confirmation of the irregular behaviour of the stability characteristics of the compounds was obtained by comparing the experimental and the theoretical curves of dynamic viscosity vs. temperature and by plotting Bachinskiy's theoretical relationship (Ref 12) between fluidity and density and comparing it with the experimental curves (Figures 6 and 7 GaSb and InSb, respectively).

Card3/a The discrepancy between the latter curves indicates a

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Thermal Stability of the Antimonides of Aluminum, Gallium and Indium in Liquid State

change in the nature of the intermolecular interaction in GaSb and InSb at high temperatures which also points to dissociation. Similar considerations probably hold in the case of AlSb, for which fluidity/density curve could not be plotted because its density in molten state was not known. Acknowledgments are made to M.S. Mirgalovskaya, L.I. Matkova, E.M. Kenova and I.A. Strelina for supply of the compounds. There are 2 figures, 1 table and 14 references, 10 of which are Soviet and 4 German.

SUBMITTED: November 24, 1967

Card 4/4

NOV/24-58-7-30/36

AUTHORS: Glazov, V.M. and Chaistyakov, Yu.D. (Moscow)  
 TITLE: Temperature Dependence of the Viscosity of Aluminium  
 (O temperaturnoy zavisimosti vyazkosti aluminia)  
 PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh  
 nauk, 1958, Nr 7, pp 141 - 143 (USSR)  
 ABSTRACT: Published results on the temperature-dependence of the  
 viscosity of aluminium are both qualitatively and  
 quantitatively divergent (Refs 1-5). Nevertheless some  
 interesting features have been reported (Refs 2,3)  
 suggesting transformations in the liquid metal. The best  
 results (Ref 4) relate to temperatures too far apart for  
 this to be checked. This was the object of the investi-  
 gation by the present authors. Two previously described  
 (Refs 6,7) types of viscosimeters (splinters in graphite  
 crucibles) were used. In one, grade AVCOO aluminium  
 (99.99% Al) was tested in an atmosphere of purified  
 argon; in the other grade AVCOO (99.99% Al) in a  
 vacuum of  $10^{-4}$  mm Hg. Density determinations were also  
 made by a method described by Chaistyakov (Dissertation  
 Moskovskiy institut tekhnykh metallov i sploynykh

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SOV/24-96 7-30/36

# Temperature Dependence of the Viscosity of Aluminum

Section Institute of Nonferrous Metals and Gold, 1936).  
 Figure 1 shows the viscosity ( $\eta$  and  $\eta'$ ) and density ( $\rho$  and  $\rho'$ ) of aluminum as functions of temperature for 650-950 °C. The curves are smoothly descending. Figure 2 shows that there is a linear relation between the logarithm of absolute viscosity and the inverse of the absolute temperature. A linear relation was also found between density and density (Figure 3), in accordance with A.L. Sachinsky's equation. Values of the free energy of activation of viscous flow of aluminum calculated from Spiegel's equation (Ref. 4) were linearly related (Figure 4) to temperature (°C). The above results all indicate the absence of polymorphic changes in liquid aluminum and of any substantial structural changes in the pre-crystallization period. The authors conclude that previous

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SOV/24-58-7-30/36

Temperature Dependence of the Viscosity of Aluminium

evidence for such changes (Ref 3) is due to experimental errors arising from the use of a coaxial type of apparatus for aluminium which easily form an oxidised surface. There are 4 figures and 9 references, 6 of which are Soviet, 2 English and 1 German

SUBMITTED: February 25, 1958

Card 3/3

GLAZOV, V. M.

12-1-17/55

AUTHORS: Petrov, D.A., Glazov, V.M.

TITLE: An Apparatus and a Method for the Investigation of the Physical-Chemical Properties of Substances in the Solid and Liquid State  
(Apparatura i metoda dlya izucheniya fiziko-khimicheskikh svoystv veshchestva v tverdom i zhidkom sostoyanii)

PERIODICAL: Zavodskaya Laboratoriya, 1958, Vol. 24, Nr 1, pp. 32-40 (USSR)

ABSTRACT: In this paper a new construction of an apparatus for the measuring of the electric conductivity and viscosity of melts at various temperatures, at the same time recording the curves of the heating or cooling of substances on Kurakov's pyrometer, as well as the carrying out of thermal analyses is recommended. A small device added to this apparatus also makes it possible to determine the dependence of the density of melts on temperature. This construction was based on the works by Meyer [Ref. 1], Shvidkovskiy [Ref. 2] and A.K. Regel' [Ref. 3]. As shown by figure 1, the apparatus consists of a double-walled quartz bell-shaped part, which is water-cooled, in the upper part, which has a piece of molybdenum tube on a conical connecting piece. In this tube, which in its upper part has a stopper of the same material, a suspended oscillating system

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An Apparatus and a Method for the Investigation of the  
Physical-Chemical Properties of Substances in the Solid  
and Liquid State

Part 1

is fitted. It consists of a tungsten wire of 50-80  $\mu$  thickness and 350 mm length, which, when oscillating, is subjected to a force of 50-100 g. The oscillation frequency is determined by the substitution of exchangeable disks which are fixed on this wire. The bell-shaped part rests upon 2 flanges which are insulated by rubber and to which the current is fed. In the interior of the bell-shaped part there is a cylinder made from refractory steel in which a closed electric furnace is fitted, which is adapted to attain temperatures of up to 2000°. The furnace is equipped in such a manner that reflection of heat towards the outside is avoided. The sample is suspended on a tungsten wire in a refractory ampule in the center of the furnace. Two thermocouples are connected with this ampule: one, the soldered joints of which are fastened on the ampule, is led outwards at the bottom, the other, which leads from the sample in the ampule to the exterior, is made to pass along the suspending tungsten wire to the exterior in an upward direction. In the interior of the bell-shaped part conditions for a vacuum have been provided. A magnetic device is fastened to the outside wall of the bell-shaped part which serves the purpose of moving the

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An Apparatus and a Method for the Investigation of the  
Physical-Chemical Properties of Substances in the Solid  
and Liquid State

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sample with the sample round its axis. The aforementioned additional device is characterized by the fact that, instead of the suspending device, a crucible with the sample is placed on to the solid baseplate of the furnace, and that a rod, which is connected with the electric circuit, is brought into contact with the surface of the melt produced therein, so that every change of the level of the melt is recorded on the outside of the apparatus. The paper mentions numerous theories and examples concerning the application of the apparatus described. There are 5 figures, 4 tables, and 6 references, 4 of which are Slavic.

ASSOCIATION: Institute for Metallurgy imeni Baykov AT USSR (Metallurgicheskii institut im. Baykova Akademii nauk SSSR).

AVAILABLE: Library of Congress

Card 3/3

1. Electrical conductance-Measurement
2. Viscosity-Determination
3. Thermal analysis
4. Pyrometers

AUTHOR: Glazov, V. A.

307/35-24-7-19/65

TITLE: The Application of the Viscosity Method in the Investigation of the Kinetics of Slowly Proceeding Reactions in the Formation of Intermetallic Compounds (Priimeneniye metoda viskoznosti dlya izucheniya kinetiki sledsvenno tekushchikh reaktsiy obrazovaniya intermetallicheskikh soedineniy)

PERIODICAL: Zavodskaya Laboratoriya, 1966, Vol. 32, Nr 7, pp. 824 - 826 (USSR)

ABSTRACT: Investigations hitherto conducted have been limited to a qualitative estimation of microscopic analyses and a subsequent determination of the time necessary for keeping the compound of the compound in a molten state until the reaction had terminated. Now as the viscosity is sensitive to small structural changes in the fluid, it is assumed that the viscosity rises as the compound is formed and then it remains constant. Proceeding from papers by Kendall(Kendal) and Monree(Monreu)(Ref 7) and by D.A.Pospelkhov (Ref 8) and using the equation by Arrhenius (Arrhenius)(Ref 9) it is assumed that the logarithm of the viscosity of the melt in a certain stage of the formation reaction of the intermetallic compound at a given temperature

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USV, 34-24-7-19/65  
The Application of the Viscosity Method in the Investigation of the Kinetics of Slowly Proceeding Reactions in the Formation of Intermetallic Compounds

adds up from the logarithm of the viscosity of the initial mixture of the components and the logarithm of the viscosity of the intermetallic compound already formed. Pertinent equations are given. Instead of the dynamic, also the kinematic viscosity can be used. The formation reaction of the intermetallic compound can be considered as irreversible. As an example the kinetics of the formation of aluminum antimonide is investigated by the viscosity method. From the results given it appears that a reaction of second order proceeds until the final stage. The constants of reaction velocity are computed for various temperatures from the pertinent equations. A good agreement with the equation by Arrhenius is reached. It was found, that the reactions should proceed slowly, as otherwise the viscosity changes during the measurement. The surface of the components must be carefully cleaned and the investigations must be conducted in a sufficiently high vacuum. The rule of the additivity of the two logarithms does not hold in all stages of the reaction. In more accurate determinations, special investigations must be carried out. This method, however, is

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The Application of the Viscosity Method in the Investigation of the Kinetics of Slowly Proceeding Reactions in the Formation of Intermetallic Compounds SNT/30-24-7-12, 65

applicable to the majority of intermetallic compounds. There are 4 figures, 2 tables, and 12 references, 11 of which are Soviet.

ASSOCIATION: Institut metallurgii i .A.A.Barkova Akademii nauk SSSR  
(Institute of Metallurgy imeni A.A.Barkov, AS USSR)

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51537

304/137-59-5-11126

18.9200

Translation from: Referativnyy zhurnal, Metallurgiya, 1989, Nr 5, pp 232-233  
(USSR)

AUTHORS: Glazov, V.M., Vigdorovich, V.N., Korol'kov, I.A.  
TITLE: Microhardness Investigations as a Method of Physical and Chemical Analysis

PERIODICAL: Sb. nauchn. tr. Nauchno-tekhn. o-vo tsvetn. metallurgii, Mosk. in-t tsvetn. met. i zolota, 1988, Nr 29, pp 135 - 142

ABSTRACT: The author describes the use of microhardness investigations as a method of physical and chemical analysis. The microhardness method is used to investigate the phenomenon of intercrystalline segregation and transformation in the solid state (changes in solubility, eutectoid, peritectoid and other transformations). The method represents a satisfactory combination of microstructural investigations with the determination of the mechanical property (hardness) of individual structural components of the alloy. In these cases the microhardness method may successfully compete with the microscopical method, which

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304/137-59-7-11120

Microhardness Investigations as a Method of Physical and Chemical Analysis

yields inaccurate results, and with the x-ray structural method when the solubility is low or when the magnitudes of atomic diameters have been approached. The application of the microhardness method for investigating the solid state solubility is possible due to the fact that proportionally to the increase in the second component of the alloy its amount increases in the solid solutions. After attaining the point of ultimate saturation at a given temperature it remains constant. As a result, the curve of variable microhardness of the solid solution has a quite determined form. The author suggests natural systems of diagrams, plotting composition versus microhardness where the phenomenon of microheterogeneization in the grains of the solid solutions of bi-phase alloys is taken into account. The microhardness method can be used to plot surfaces of limited solubility in three-component systems (with the aid of the isotherm of composition versus microhardness of crystals of the solid solution for any section of the structural diagram) and to plot the solidus of binary and triple systems (with the use of isotherms or polytherms of microhardness).

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20-118-5-21/59

AUTHORS: Glazov, V. M., Vigdorovich, V. M.

TITLE: On the Problem of Diffusion-Free Crystallization of Metal Alloys  
(K voprosu o bezdiffuzionnoy kristallizatsii metallicheskih  
splavov)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol. 118, Nr 5, pp. 924-927  
(USSR)

ABSTRACT: A. A. Popov (Ref. 12) on the basis of the theory of diffusion-free transformations (References 9,10,11) developed ideas on a possibility in principle of the diffusion-free crystallization of alloys. Based on these ideas the present paper investigates the simultaneous influence of the cooling speed and the composition of the alloy on the degree of the ramification of the dendrite forms during the growth of the crystals. Two possible types of interaction between the components are taken into consideration here. Then it is briefly reported on the behaviour of the alloys during an undercooling. The dependence of the degree of ramification of the dendrites of the cooling speed in the crystallization has a maximum which corresponds to the critical cooling speed for a given alloy. The modification of composition of the

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. On the Problem of Diffusion-Free Crystallization of Metal Alloys 20-118-5-21/59

alloy in a given cooling speed has an influence on the ramification of the dendrite forms of the growth of the crystals of the following kind: An amplification of the content of the second component in all crystallizing alloys lowers the degree of undercooling of the crystallizing alloys of different composition. In the alloys of undercritical cooling speed an amplification of the content of the second component must lower the ramification of the dendrites as a consequence of the lowered degree of undercooling. The peak of the curve representing the dependence of the degree of ramification of the dendrites on the cooling speed in an amplification of the content of the second component in the alloy must move towards a higher cooling speed. Then the increase of the temperature stability of the developing solid solution is discussed. The most important conclusion from the present paper is the following: The microheterogeneity of the crystals of the solid solution of two-phase alloys must have a maximum at certain medium cooling speeds (which correspond to the critical cooling speeds). This final conclusion is of importance for the development of processes for the crystallization of heat-resisting alloys. There are 3 figures and 21 references, 20 of which are Soviet.

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On the Problem of Diffusion-Free Crystallization of Metal Alloys 20-113-5-21/59

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akad. Nauk SSSR  
(Institute for Metallurgy imeni A. A. Baykov of the AS USSR)  
Moskovskiy institut tsvetnykh metallov i zolota im. M. I.  
Kalinina (Moscow Institute for Nonferrous Metals and Gold imeni  
M. I. Kalinin)

PRESENTED: August 20, 1957, by G. V. Kurdyumov, Member, Academy of Sciences,  
USSR

SUBMITTED: August 14, 1957

Card 3/3

AUTHORS: Petrov, D. A., Grunov, V. M.

257,26-72-2-18/63

TITLE: On Variations in the Short-Range Order Structure During Pre-crystallization in Semiconducting Chemical Compounds With a ZnS Type Lattice (Ob izmeneniyakh v strukture blizhnego porjadka v predkristallizatsionnyy period u poluprovodnikovykh khimicheskikh soedineniy s reshetkoy tipa ZnS)

PERIODICAL: Doklady Akademii nauk SSSR, 1963, Vol. 170, Nr 2, pp. 283 - 290 (USSR)

ABSTRACT: In this paper a number of particular features of the variation of the short-range order structure of a group of semiconducting chemical compounds having a zincblende type of structure. According to the results gained in a number of previous papers the density and the electric conductivity of a compound with a zincblende type of structure increases considerably during melting. These facts indicate large differences between the structure of the solid and of the liquid crystals of these compounds. At the same time an investigation of the temperature dependence of the viscosity of the compounds AlSb, GaSb, InSb (exhibiting a ZnS structure)

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On Variations in the Short-Range Order Structure During Precrystallization in Semiconducting Chemical Compounds With a ZnS Type Lattice

0.7/0-70-2-10/65

shows that in the precrystallization period considerable deviations from the results by A.I. Sachinskii are found, which are often more pronounced than in pure metals. These deviations in a given liquid phase indicate a modification of intermolecular interaction. In metals these deviations are apparently connected with the stages preceding crystallization and with the formations of domains with an ordered structure. They are caused by modifications of the short-range order in these melts. A diagram illustrates the results of the computations carried out according to a given formula. The curves showing the variation of  $F_{\text{visc}}$  versus the temperature of all three investigated compounds exhibit a pronounced minimum at temperatures ranging from about 20 to 50° above the crystallization temperature of the compound in question.  $F_{\text{visc}}$  denotes the free energy of activation of the free flowing of the liquid. The modifications in the short-range structure in the precrystallization period in these compounds are directed towards a reduction of the coordination number and, hence, also towards a reduction of density. For the very same reason the increase of the free activation energy

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On Variation in the Short-Range Order Structure  
During Recrystallization in Semiconducting Chemical  
Type Lattice

of viscous flow at a reduction of temperature can be explained.  
Corresponding to these modifications of the short-range structure  
the character of the conductance is explained. To be cited: **Fig. 1**  
and **7 Soviet references.**

ASSOCIATION: Institute of Solid State Physics, Academy of Sciences of the USSR (Moscow)  
of the Academy of Sciences of the USSR (Moscow)

PRESENTED: December 15, 1966, by I.P. Bardin, Member, Academy of Sciences of the USSR

SUBMITTED: December 15, 1966

1. Intermetallic compounds--Structural analysis
2. Intermetallic compounds--Lattices
3. Intermetallic compounds--Temperature factors
4. Mathematics--Applications

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5(4)

SCV/20-123-3-31/54

AUTHORS:

Glazov, V. M., Vertman, A. A.

TITLE:

On the Behavior of the Antimonides of Aluminum, Gallium, and Indium in the Liquid State (O povedenii antimonidov alyuminiya, galliya i indiya v zhidkom sostoyanii)

PERIODICAL:

Doklady Akademii nauk SSSR, 1958, Vol 123, Nr 3, pp 492-494 (USSR)

ABSTRACT:

The present paper investigates the temperature dependence of the magnetic susceptibility of the antimonides of aluminum, gallium, and indium in the liquid state; the data obtained are compared with several thermodynamic and kinetic properties of these compounds. Such investigations are also of practical importance. Reference is made to several previous papers. As initial materials AlSb, GaSb, and InSb samples were used, which were purified before the experiments by means of recrystallization by zones and by extraction. Magnetic susceptibility was determined by the Faraday (Faradey) method. The results obtained by these measurements are shown by a diagram. The temperature dependences of the magnetic susceptibility of AlSb, GaSb and InSb in the liquid state are very similar to one other. Therefore, equal or very similar processes probably take place when the three

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On the Behavior of the Antimonides of  
Aluminum, Gallium, and Indium in the Liquid State

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compounds mentioned are heated. The curves for the temperature dependence of magnetic susceptibility have two maxima. The first curve for the temperature dependence of the magnetic susceptibility of the aforementioned substances agrees fairly accurately with the minimum of the curve for the temperature dependence of the free activation energy of viscous flow. The minimum of the curve of magnetic susceptibility corresponds approximately to those temperatures at which the curves of viscosity temperature dependence deviate from the regular course. The following conclusions can be drawn from the results of this paper and of previous investigations: at melting temperature, the above mentioned compounds have approximately the same structure of the near order as in the solid state. With rising temperature, the coordination number increases and at a certain temperature it approaches the dense packing. There are 1 figure and 7 references, 6 of which are Soviet.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences, USSR)  
PRESENTED: July 12, 1958, by G. V. Kurdyumov, Academician  
SUBMITTED: June 28, 1958  
Card 2/2

CHARTER, T. M.: "The Role of the (U.S.) in the Development of the  
Properties of the Anticorrosion of Alloys, Metals, and Polymers in the  
Field". Moscow, 1970. 21 pp. (U.S. Gov. Print. Off., Wash., D.C.),  
1970. 21 pp. (U.S. Gov. Print. Off., Wash., D.C.), 1970.

ANENITSKAYA, R.V.; BATALOV, A.P.; GLAZOV, V.M.; KORSHUNOV, I.A., prof.;  
KUTSEPIN, V.F.; NOVOGOROV, N.F.; ORLOVA, A.A.; PETERIL, A.M.;  
SHAFIYEV, A.I.

[Problems in radiochemistry] Sbornik zadach po radiokhimii.  
[By] R.V. Anenitskaia i dr. Pod red. I.A. Korshunova. Gor'kii,  
Gor'kovskii gos. univ. im. I.I. Lobachevskogo, 1958. 91 p.  
(MIRA 15:11)

1. Prepodavateli khimicheskogo fakul'teta Gor'kovskogo gosudar-  
stvennogo universiteta im. I.I. Lobachevskogo (for all)  
(Radiochemistry)



SOV/150-59-1-11/29

AUTHORS: Vertman, A.A. and Glazov, V.M. (Moscow)

TITLE: Magnetic Susceptibility of Aluminium-Antimony and Gallium-Antimony Alloys in the Liquid State (O magnitnoy vospriimchivosti splavov alyuminii - sur'ma i galiy - sur'ma v zhidkom sostoyanii)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 1, pp 60-63 (USSR)

ABSTRACT: The work described was devoted to the study of reactions at various temperatures between components in the liquid alloys aluminium-antimony and gallium-antimony. This field is of interest because in such systems compounds with semiconducting properties are formed. The investigation was based on measurements of magnetic susceptibility at various temperatures for liquid alloys in the following composition ranges (at %): 25-70 Sb, 75-30 Al; and 25-75 Sb, 75-25 Ga. The respective temperature ranges were about 1090-1350 and 710-1150°C. Faraday's method was used with a previously-described apparatus (Ref 3). The susceptibilities as functions of temperature are shown for the aluminium alloys (3g samples) in Fig 1 and for the gallium alloys (0.5g samples) in Fig 2 (curve numbers

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SOV/180-59-1-11/29

Magnetic Susceptibility of Aluminium-Antimony and Gallium-Antimony Alloys in the Liquid State

correspond to alloys numbers in the table). The curves fall continually with increasing temperatures except those for the 50-50 at.% samples (antimonides) (curves 4) which first rise, then fall, then rise and fall again. The authors explain the latter effect in terms of structural changes and dissociation, this being supported by published viscosity studies (Ref 5). They go on to consider the concentration-dependence of the magnetic susceptibility at various temperatures, shown in Figs 3 and 4 for the aluminium and gallium systems, respectively, together with the equilibrium diagrams. The minima on the susceptibility isotherms at 50 at.% became less pronounced with increasing temperature, and for the aluminium system the minimum disappears at 1300°C. The evidence of dissociation of AlSb and GaSb at 1200 and 1000°C respectively, is in line with that from viscosity

Card 2/3

SOV/180-59-1-11/29  
Magnetic Susceptibility of Aluminium-Antimony and Gallium-Antimony  
Alloys in the Liquid State

studies.

There are 4 figures, 1 table and 7 references, 6 of which  
are Soviet and 1 English.

SUBMITTED: August 4, 1959

Card 3/3

67792

5.4110  
5.2610

SOV/180-59-4-25/48

AUTHORS:

Glazov, V.M., Petrov, D.A. and Chizhevskaya, S.N.  
(Moscow)

TITLE:

The Joint Solubility of Elements of Groups Three and Five in Germanium

PERIODICAL:

Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1959, Nr 4, pp 153-155 (USSR)

ABSTRACT:

Pure germanium,  $\text{AlSb}$ ,  $\text{GaSb}$  and  $\text{InSb}$  were used. Ge-GaSb and Ge-InSb alloys were prepared in an evacuated quartz flask at  $1000^\circ\text{C}$  and Ge-AlSb at  $1250^\circ\text{C}$ . They were held for one hour with periodic stirring and then the flask was immersed in cold water. Examinations under the microscope showed that alloys of Ge with up to 3 wt % AlSb, 2.5 wt % GaSb or 0.5 wt % InSb were single-phased. Microhardness measurements were also taken to determine the limiting solubility in the solid state. Results are given in Table 2 and phase diagrams constructed in Fig 1, 2 and 3. Maximum solubility by this method was 3% for AlSb, 2.5% for GaSb and 0.7% for InSb. The results show that the antimonides are more soluble in germanium than the pure elements aluminium, gallium and indium. This is explained by the fact that donor and acceptor elements

Card 1/2

61292

SOV/156-59-4-25/48

The Joint Solubility of Elements of Groups Three and Five in Germanium  
are more soluble together than separately. There are  
3 figures, 2 tables and 7 references, 3 of which are  
Soviet and 4 English.

SUBMITTED: April 24, 1959

Card 2/2

KORSHUNOV, I.A.; NOVOTOROV, N.F.; AMENITSKAYA, R.V.; OKHOLOVA, I.S.;  
PESTUNOVICH, N.A.; DUBOVSKAYA, V.N.; LEONOV, M.R.; GLAZOV,  
V.M.

Synthesis of organic compounds tagged with radioactive car-  
bon. Radiokhimiia 1 no.6:728-733 '59. (MIRA 13:4)  
(Carbon--Isotopes) (Organic compounds)

5(2); 18(4); 18(7)

AUTHORS:

Glazov, V. M., Vvedenskiy, V. M., Korol'kov, G. A.

TITLE:

Investigation of the Interaction Between Aluminum and Niobium  
(Issledovaniye vzaimodeystviya aluminiya i niobiya)

PERIODICAL:

Zhurnal neorganicheskoy khimii, 1969, Vol. 4, No. 7,  
pp 1620-1624 (USSR)

ABSTRACT:

Although Al-Nb alloys have been known for a long time, the phase diagram has been little investigated. Because of the great difference in the melting temperatures of the two metals, Nb was dissolved in liquid aluminum overheated up to 1500-1600°. As a result of the analysis carried out in the chemical laboratory of the Institute, mentioned first under the heading of Association, the initial alloy contained 10% Nb. Alloys with a niobium content of between 0.04 and 9 weight% Nb were produced. An investigation of the microstructure of the alloys showed that, with an addition of more than 0.19 weight% Nb, the size of the grain is considerably reduced (Fig 1). This point of the diagram corresponds to the beginning of the separation of primary crystals of the compound NbAl<sub>3</sub>. Investigation of microstructure showed the existence of NbAl<sub>3</sub>-crystals

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ISSN 0013-788X/78-0002-0004-0

# Investigation of the Interaction Between Aluminum and Niobium

in the alloys which were homogenized at 640° and containing more than 0.25 weight% Nb, and that the quantity of these crystals increases with increasing Nb-content (Fig. 2). An investigation of microhardness (Fig. 3a) showed a temperature-dependent limited solubility of Nb in Al (Fig. 3b, Table 2) which amounts to 0.22 weight% at 668° and to 0.08 weight% at 20°. Thermal analysis showed a thermal effect at 669.5° in the case of all alloys beginning with 0.20 weight% Nb and more, which indicates a non-variant character of the conversion. The Al-corner of the phase diagram Al-Nb is shown by figure 5. At 669.5° peritectic equilibrium is established:  

$$L + NbAl_7 \longrightarrow \alpha$$
The behavior of the Al-Nb-alloys proves a far-reaching analogy of the chemical behavior of niobium and tantalum. There are 3 figures, 1 table, and 4 references, 3 of which are Soviet.

## ASSOCIATION:

Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute for Metallurgy named A. A. Baikov of the Academy of Sciences, USSR) Moskovskiy institut tsvetnykh metallov i zolota im. M. I. Kalicina (Moscow Institute for Non-ferrous

Card 2/3



Investigation of the Interaction Between Aluminum and Niobium

SSV/TS-1-7-26/84

Metals and Gold (auth M. I. Kalinin)

SUBMITTED: April 14, 1958

Card 1/1

SOV/89-21-1-3/21

5(4)

AUTHORS: Glazov, V.M. and Vigdorovich, V.N.

TITLE: On the Colloidal State of the Solid Solution in the  
Metallic Systems of the Two Phase Alloys (O kolloid-  
al'nom sostoyanii tvërdogo rastvora dvukhfaznykh  
splavov metallicheskih sistem)

PERIODICAL: Kolloidnyy zhurnal, 1959, Vol XXI, Nr 1, pp 18-24 (USSR)

ABSTRACT: The transition of heterogenized crystals of solid  
solution from a metastable to a stable state has been  
studied from a kinetic standpoint, based on the micro-  
hardness studies of the crystals of two-phase solid-  
solution alloys of a number of binary systems. The  
transition has been shown to occur in two stages. The  
phenomenon is treated on the basis of the colloidal  
state of crystals of the solid solutions. There are  
3 sets of graphs, 1 table, 1 diagram and 4 Soviet  
references.

Card 1/2

ON/69-21-1-5/21

On the Colloidal State of the Solid Solution in the Metallic  
Systems of the Two Phase Alloys

ASSOCIATION: Institut metallurgii AN SSSR im.A.A. Baykova (The  
Institute of Metallurgy of the AS USSR imeni A.A.  
Baykov); Moskovskiy institut tsvetnykh metallov i  
zolota im.M.I. Kalinina (The Moscow Institute of Non-  
Ferrous Metals and Gold imeni M.I. Kalinin).

SUBMITTED: April 17, 1957

Card 2/2

5(4)

007/09-21-4-6/22

AUTHOR: Vindorovich, V.M. and Glazov, V.K.

TITLE: Kinetic Study of the Transition of the Crystals of Two-Phase Binary Solid Solution Alloys From the Metastable to the True Homogeneous State

PERIODICAL: Kolloidnyi zhurnal, 1954, Vol. XVI, No. 4, pp. 409-412 (USSR)

ABSTRACT: This is an experimental study of the transition of two-phase systems of binary solid solution alloys from a heterogeneous to a homogeneous state. The authors investigated the systems copper-titanium and copper-zirconium, in the crystals of which the intermetallic compounds Cu<sub>3</sub>Ti and Cu<sub>3</sub>Zr appear as a heteroquaternary element. The authors' investigation is divided into three parts comprising: 1) study of the kinetics of homogenization; 2) determination of a constant relation between the energy of activation of the transition and the heat of solution of the second phase; and 3) an appreciation of the mechanism of the transition process on the basis of the obtained results. The authors star-

Card 1/4

07/89-11-1-6/89

Kinetic Study of the Transition of the Crystals of Two-Phase Binary Solid Solution Alloys From the Colloidal to the True Homogeneous State

bed from the assumption that the mentioned intermetallic compounds (second phase) considerably affect the hardness of the crystals of the solid solution. The measuring of the hardness of the crystals therefore, served as the basis of the investigation of the kinetics of the transition. The experiments were carried out at temperatures of 100, 125, 150, 175 and 200°C and with shorter (graphs 1 and 2) and prolonged (up to 400 hours) tempering periods. Only prolonged tempering at temperatures of 150, 175 and 200°C resulted, through the obtaining of stable values for the hardness of the crystals, i.e. the elimination of the second phase, in a true homogenization of the solid solution (graph 4). Graph 4 shows the dependence of the hardness of the crystals on the time of tempering at various temperatures in a generalized form. As to the latter, the authors assume two periods, one qualified as aggregational and the other as kinetic with reference to the hardness of the crystals. The first is characterized by a re-

Card 2/4

1971-4-21-4-6/22

# Kinetic Study of the Transition of the Crystals of Two-Phase Binary Solid Solution Alloys From the Colloidal to the True Homogeneous State

laxing of the inner stresses in the layers which surround the particles of the colloid solution of the second phase and by a dissolving process of the less resistant particles of the second phase. The second period is characterized by diffusion processes, as a result of which the boundaries between the phases in the crystals of the solid solution disappear. On the basis of an equation obtained for the rate of diffusion, the authors found exact values for the energy of activation of the transition of the concerned systems from a heterogeneous to a homogeneous state. These values are 147.500 and 261.300 cal/gram atom for the system copper-titanium and copper - zirconium, respectively. Table 2 and the following equation show the close relation between the energy of activation of the systems and the heat of solution of the respective second components ( $Q_1$  and  $Q_2$ ). The first is directly proportional to the second. On the basis of the obtained results, the authors conclude that in the heterogenized crystals two processes can be observed: the levelling of chemical hetero-

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SV/20-1-4-1/22

Kinetic Study of the Transition of the Crystals of Two-Phase Binary Solid Solution Alloys From the Colloidal to the True Homogeneous State

processes by diffusion and the appearance of a new heterogeneity due to the varying solubility of the second component in the layers which surround particles of different size. If these processes lead to the dissolving of the smaller, and the growth of the larger particles. In this way the transition of colloidal crystals of the solid solution to a homogeneous state is accomplished by maximum diffusion. Dissolution of the atoms of the second component through dissolving and settling processes. There are 6 graphs, 2 tables and 10 Soviet references.

ASSOCIATION: Institut tsvetnykh metallov imeni M.I. Melnikova (Institute of Non-Ferrous Metals imeni M.I. Melnikova)  
Institut metalurgii AN SSSR imeni A.A. Bagdadya, Moskva  
(Institute of Metallurgy of the AN SSSR imeni A.A. Bagdadya, Moscow)

SUBMITTED: 29 March, 1956  
Card 4/4

00V/32-25-1-24/51

18(7)

AUTHORS:

Glasov, V. M., Vinderovskii, V. I.

TITLE:

Application of the Method of Micro-Hardness to the Plotting of Conodes Within the Two-Phase Region of the Three-Component Phase Diagrams (Primeneniye metoda mikroverdosti dlya postroyeniya konod v dvufaznykh oblastyakh troykompontentnykh diagramm sostoyaniya)

PERIODICAL:

Zavodskaya laboratoriya, 1977, Vol. 21, No. 1, pp 57 - 62 (USSR)

ABSTRACT:

The method mentioned in the title is applied to metallic systems and the results of some conode plottings on real systems are specified. To determine the conode position within the diagram two-phase region (solid or solid-liquid phase region) two imaginary points must be found at the concentration triangle, corresponding to two alloys, in which the crystals of the solid solution have the same concentration. This can be done by the aid of the rules governing the change in crystal micro-hardness. If the crystal micro-hardness in solid solution in the two-phase alloy of the three-compo-

Card 1 2



Application of the Method of Micro-Hardness to the  
Plotting of Conodes Within the Two-Phase Range of the Three-Component Phase  
Diagrams

007/52-25-1-24/51

When the alloy composition is known, the alloy composition can be determined according to the intersection point of the isosclere (which corresponds to the micro-hardness value) with the solubility isothermal line or solidus. In this way a fixed position of the conode can be determined. Conodes for the systems Al-Mg-Si, Cu-Cr-Zr and Cu-Al-Ti were plotted by the method described and the micro-hardnesses of some alloys were investigated in connection therewith (Figs 2,3,4). The cross sections investigated were found to be really conodes. In the system Cu-Al-Ti (no figure) the case was observed that the position of the second "direction point" remains unchanged and that all conodes coincide there (Cu,Ti). For the system Cu-Zn-Sn (Fig 4) the applicability of the method described is restricted within certain limits. There are 5 figures, 2 tables, and 6 references, 5 of which are Soviet. Institut metallurgii im. A. A. Baykova Akademii nauk SSSR i Moskovskiy institut sovetskikh metallov i zolota im. I. I. Kalinina (Institute of Metallurgy imeni A.A.Baykov AS USSR and Moscow Institute for Nonferrous Metals and Gold imeni M.I.Kalinin)

ASSOCIATION:

Card 2/2

05810

SOV/76-33-10-8/45

5(4), 18(7)

AUTHORS: Glazov, V. M., Vigdorovich, V. N.

TITLE: A Contribution to the Investigation of the Kinetics of Dissociation and Formation of Intermetallic Compounds in Melts by the Method of Viscosity Measurement

PERIODICAL: Zhurnal fizicheskoy khimii, 1959, Vol 33, Nr 10, pp 2164-2168 (USSR)

ABSTRACT: The formation and dissociation of intermetallic compounds have not yet been investigated since there are no methods available for determining the concentration of the substances during the reaction. For this purpose it is, however, possible to use the measurement of the melt viscosity. The applicability of the viscosity method is exemplified by investigating the kinetics of chemical reactions of the first, second, third, and n-th order under neglect of the chemical reactions occurring in the solution. On the basis of the Arrhenius equation (1) some theoretical conditions are discussed, and the authors refer to publications by Kendall, Monroe and Wright (Refs 4, 5) and D. A. Pospekhov (Ref 6), etc. Further, corresponding equations are derived for the four afore-mentioned reaction orders. Experiments were made with the help of the formation of aluminum antimonide. Viscosity was checked at 1090, 1120, 1150 and

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05810

SOV/76-33-10-3/45

A Contribution to the Investigation of the Kinetics of Dissociation and Formation of Intermetallic Compounds in Melts by the Method of Viscosity Measurement

1200 C as a function of time. Interpretation of the resultant data has shown that the reaction under discussion was of second order and could be represented by  $Al + Sb \rightarrow AlSb$ . Further, the authors calculated the constant of reaction rate for the afore-mentioned temperatures (Table ) and found that the dependence of the logarithm of the constant on the reciprocal temperature value corresponded to the above Arrhenius equation. The resultant activation energy of aluminum antimonide formation amounts to  $21,500 \pm 200$  cal/mol. There are 1 table and 8 references, 4 of which are Soviet.

ASSOCIATION: Akademiya nauk SSSR, Institut metallurgii im. A. A. Baykova.  
Institut tsvetnykh metallov i zolota im. M. I. Kalinina  
(Academy of Sciences of the USSR, Institute of Metallurgy imeni  
A. A. Baykov. Institute for Nonferrous Metals and Gold imeni  
M. I. Kalinin)

SUBMITTED: March 12, 1958

Card 2/2

67271

5.4110  
24.7600  
5(1), 5(2)  
AUTHORS:

SOV/20-129-4-43/68

Glazov, V. M., Chizhevskaya, S. N.

TITLE:

Resistivity to Heat of the Antimonides of <sup>v1</sup>Aluminum, <sup>v1</sup>Gallium, and <sup>v1</sup>Indium Dissolved in Molten <sup>v1</sup>Germanium

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 4, pp 869-872 (USSR)

ABSTRACT:

The authors wanted to draw a conclusion on the state of the antimonides dissolved in Ge on the basis of the investigation of the intramolecular interaction in systems Ge-A<sup>III</sup>Sb (where A<sup>III</sup> is Al, Ga, In). In references 1-4 a method for the analysis of the interaction in binary systems is described. To use this method for the solution of this task the phase diagrams of Ge-A<sup>III</sup>Sb and of the heat of fusion of germanium must be known. The quasi-binary systems Ge-A<sup>III</sup>Sb the position of which in the concentration triangle may be seen in figure 1 are described by phase diagrams eutectic type with a limited solubility in solid state. Since the solubility of Al, Ga, and In is very low in this state (Ref 6), equation (2) may be used for the corresponding calculations. Figure 2 shows the liquidus curves

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Resistivity to Heat of the Antimonides of Aluminum, Gallium, and Indium  
Dissolved in Molten Germanium

which correspond to the primary crystallization of germanium in this system. The calculations on the basis of (2) show that the mixing energy of aluminum antimonide with germanium is near zero. The experimentally found liquidus curve agrees practically with the calculated curve. This indicates that the solutions of aluminum antimonide in germanium are approximated to the ideal solutions. In the dissolution of gallium- and indium antimonide in germanium considerable deviations from the ideal state are observed. This is indicated by considerable divergencies of the experimentally found liquidus lines and of the lines found on the basis of equation (2) (under the assumption that  $V' = 0$ ) (Fig 2). The mixing energy is here negative and increases with the temperature of the liquidus and with the dilution of the solution. Apparently the change of the mixing energy in the formation of solutions (Table 1) is connected with the changes of the gallium and indium anti-

4

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Resistivity to Heat of the Antimonides of Aluminum, Gallium, and Indium  
Dissolved in Molten Germanium

monide dissociation degree according to the temperature with respect to the liquidus lines of these systems. Figure 3 shows the dependences  $\ln x_{\text{Ge}} - 1/T_{\text{liq}}$  for the systems

Ge-A<sup>III</sup>Sb. On the basis of the above analysis the authors arrive at the conclusion that in molten germanium the aluminum antimonide dissolved in germanium at temperatures which do not exceed those of the heat of fusion of germanium does not dissociate or only to a slight degree into very weak components. The antimonides of gallium and indium however, are considerably dissociated. Their intensive dissociation begins at lower temperatures compared to pure compounds. Thus a germanium medium somewhat reduces the resistivity to heat of the dissolved compounds. This weakening effect of the germanium medium is obviously connected with its dielectric properties. The authors thank D. S. Kamenetskaya for advice. There are 4 figures, 1 table, and 11 references, 9 of which are Soviet. ✓

Card 3/4

67271  
SOV/20-129-4-43/68  
Resistivity to Heat of the Antimonides of Aluminum, Gallium, and Indium  
Dissolved in Molten Germanium

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR  
(Institute of Metallurgy imeni A. A. Baykov of the Academy  
of Sciences, USSR)

PRESENTED: July 13, 1959, by G. V. Kurdyumov, Academician

SUBMITTED: June 5, 1959

Card 4/4

1903h  
3/021/61/021/013/003/027  
B1A/B1A

18 7540

AUTHOR: Glazov, V. M.

TITLE: Characteristics of the change of structure and of the character of the chemical bond of semiconductors during melting

ABSTRACT: Referativnyi Zhurnal, no. 10, 1961, 30, Abstract 1-B260 (Sl. "Stroenie i svoystva kristallov". 3, 1961, 104 - 114)

TEXT: The characteristics of the change of structure and of the character of the chemical bonds in semiconductor materials with diamond and zinc-blende structures (Ge, Si, InSb, GaSb, Bi, Au, Al) are considered on the basis of publications. The relations between various parameters (density, coordination structure, and electrical conductivity) are discussed. The dependence of density on fluidity at different temperatures and the temperature dependence of the free activation energy  $F$  of a viscous flow are also discussed. All these quantities are considered in connection with the change of the character of the chemical bond and of the band 1/2



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F100/2101

Characteristics of the change..

structure during the transition from the solid state into the liquid state and with an increase of the coordination number  $n$ , this transition, as well as in the "oriented melting" process. The deviation from the Eyring equation  $V = a + bV$  of  $G_0$  and  $H_0$  is considered. It is assumed that density and coordination number as functions of temperature are described by curves having a maximum in a temperature range which is not much higher than the melting point. 40 references. [Abstractor's note: Complete translation.]

Part 2/1

S/061/61/000/012/009/085  
B101/B110

AUTHOR: Glazov, V. M.

TITLE: Interaction of alloying constituents in liquid ternary alloys

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 19, 1961, 45, abstract  
19B333 (Sb. "Stroyeniye i svoystva zhidk metallov", M., 1960,  
115 - 123)

TEXT: The method of damped oscillations of a cylinder containing a melt and a vacuum viscosimeter were used to study the viscosity of liquid solutions of the ternary systems Ge - Al - Sb and Si - Al - Sb. Viscosity isotherms showed blurred maxima at the intersection with the quasibinary cross section Ge(Si) - AlSb, which indicates that AlSb dissociates in melts. [Abstracter's note: Complete translation.] ✓

Card 1/1

5.2610

5.4120

82629  
S/180/60/000/004/024/027  
E111/E452

AUTHORS: Glazov, V.M. and Lyu Chzhen'-Yuan (Moscow)  
TITLE: Investigation of Separate and Combined Solubility  
of Aluminium and Antimony in Silicon  
PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh  
nauk, Metallurgiya i toplivo, 1960, No. 4, pp. 150-155

TEXT: The electrical properties of semiconductor materials are determined by the amount and state of their impurities. The authors state that insufficient work has been published on the solubility and interaction of various impurities. For their investigation they prepared series of binary (0.1 to 3.0% Al, remainder Si; 0.07 to 1.48% Sb, remainder Si) and ternary (0.08 to 2.35% Al, 0.02 to 2.2% Sb, remainder Si) alloys. Starting materials were grade AV-0000 aluminium (99.998% Al), grade Su-000 antimony (99.995% Sb) and 99.9999% pure Si. Melting was effected on a high-frequency furnace in an argon atmosphere. After holding for some time, the alloys were cooled at a rate of about 500 to 600°C/min in the crystallization-temperature region. As Glazov has shown (Ref. 9) this produces a homogeneous ingot cross-section. The cast alloys were annealed at 1000°C for

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E111/E452

Investigation of Separate and Combined Solubility of Aluminium and Antimony in Silicon

170 hours in vacuo or argon (for Si-Al). This was followed by annealing at 1200 to 600°C for 170 to 1500 hours and quenching in water. For some alloys further heat treatment followed. Polished sections were prepared for studies of microstructures and the dependence of microhardness of solid-solution crystals on alloy composition. Fig.2 and 3 show this dependence and the solubility limits for the binary and ternary (sections of the ternary diagram are shown in Fig.4) solution. Fig.4 also shows the solubility isotherms. The authors analyse the nature of the aluminium and antimony solubility curves in silicon and also the nature of the solidus surface and micro-hardness relation for the ternary solid solution. They conclude that there is preferential chemical reaction between aluminium and antimony in a silicon-base solid solution. There are 5 figures, 1 table and 10 references 5 Soviet, 3 English and 2 German.

SUBMITTED: February 23, 1960

Card 2/2

24.7700 1143, 1164, 1151  
18 8120 1045 only

36083  
S/180/60/000/005/025/033  
E193/E183

AUTHOR: Glazov V.M. (Moscow)

TITLE: Viscosity and Electrical Conductivity of the Aluminium-Antimony, Gallium-Antimony, and Indium-Antimony Alloys in the Liquid State

PERIODICAL: Izvestiya Akademii nauk SSSR Otdeleniya tekhnicheskikh nauk Metallurgiya i toplivo, 1960, No. 5, pp. 190-194

TEXT: The concentration- and temperature-dependence of viscosity  $\eta$ , and electrical conductivity  $\sigma$ , of liquid Al-Sb, Ga-Sb and In-Sb alloys was determined, and isotherms of these properties were constructed for the temperature range extending to approximately 400 °C above the highest melting point of each of the systems studied. An intermetallic compound (antimonide) is formed in each of these systems and it was found that  $\eta$  of these compounds, at temperatures immediately above their melting points, was considerably higher than that of the other alloys in the appropriate system, this difference decreasing with rising temperature. The temperature coefficient of  $\eta$  of respective

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S/180/60/000/005/025/033

E193/E183

Viscosity and Electrical Conductivity of the Aluminium-Antimony, Gallium-Antimony and Indium-Antimony Alloys in the Liquid State

antimonides was higher than that of other alloys. Similarly,  $\sigma$  of the intermetallic compounds at temperatures immediately above their melting points was lower than that of other alloys in each system, the intermetallic compounds having the lowest temperature coefficient of  $\sigma$ . The isotherms of  $\eta$  and  $\sigma$  for relatively low temperatures (immediately above the melting point of the intermetallic compounds) had sharp extrema: a maximum in the case of  $\eta$ , and a minimum in the case of  $\sigma$ . With rising temperature, these extrema became gradually less pronounced and, in the case of  $\eta$ , were shifted towards the more viscous component of the system. The results obtained proved conclusively that the degree of dissociation of aluminium, gallium and indium antimonides at temperatures just above their melting point is very low. There are 2 figures, 1 table and 18 references, 13 Soviet and 5 non-Soviet.

SUBMITTED March 22, 1960

Card 2/2

36698

18.7510 1449, 1454

S/180/60/000/006/008/030  
E021/E335

AUTHORS: Glazov, V.M. and Stepanova, M.V. (Moscow)

TITLE: The Chemical Interaction Between the Alloying  
Components in Copper-based Ternary Solid Solutions

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye  
tekhnicheskikh nauk, Metallurgiya i toplivo,  
1960, No. 6, pp. 61 - 64

TEXT: An investigation of the ternary copper-chromium-  
zirconium and copper-nickel-beryllium systems which form the  
molecules  $\text{Cr}_2\text{Zr}$  and  $\text{NiBe}$  was carried out. These systems are  
of interest from a practical point of view since high conductive  
heat-resistant alloys are prepared from them. Microhardness  
values were taken of the quenched solid solutions of various  
compositions along sections, as shown in Fig. 1, intersecting  
the quasi-binary  $\text{Cu-Cr}_2\text{Zr}$  and  $\text{Cu-NiBe}$  sections. Samples  
were rolled with 50% deformation, held at  $1\,000^\circ\text{C}$  for two  
hours and quenched in cold water. Sections were then prepared  
for microhardness testing, removing the cold work on the

Card 1/2

86698  
S/180/60/000/006/008/030  
E021/E335

The Chemical Interaction Between the Alloying Components  
in Copper-based Ternary Solid Solutions

surface by etching in 3% ferric chloride - 10% aqueous  
hydrochloric acid solution. The results are shown in  
Figs. 2 and 3, where microhardness values are plotted against  
composition. There are minima in all the curves at the  
compositions corresponding to the compounds  $\text{Cr}_2\text{Zr}$  and  $\text{NiBe}$ .

This can be explained by the fact that the lattice is  
distorted to a lesser degree when the chemical compounds are  
present than when the solute atoms are in a disordered  
arrangement. There are 3 figures, 1 table and 5 Soviet  
references.

SUBMITTED: April 23, 1960

Card 2/2



86702

24.7700

1043.1143.1159 S/180/60/000/006/020/030  
E111/E335

AUTHOR: Glazov, V.M. (Moscow)

TITLE: Characteristic Features of Changes in the Nature of  
Chemical Bonds and Structure of Semiconductors on  
Melting

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye  
tekhnicheskikh nauk, Metallurgiya i toplivo,  
1960, No. 6, pp. 111 - 116

TEXT: In the solid phase the majority of semiconductors have  
a loosely packed structure with low coordination numbers. For  
example, germanium, silicon and many semiconducting compounds  
have a structure of diamonds or zinc blende, a coordination  
number of 4, and a system of rigid covalent bonds. The  
temperature dependences of the electrical conductivity and  
density of germanium, silicon, gallium antimonide and indium  
antimonide are shown in Fig. 1 for temperatures below and above  
the melting point (A.R. Regel's data). On melting, the  
lattice of these compounds is destroyed and they assume a more  
closely packed structure of metallic type. For example,  
Card 1/4

86702

S/180/60/000/006/020/030  
E111/E335

# Characteristic Features of Changes in the Nature of Chemical Bonds and Structure of Semiconductors on Melting

germanium at 1 000 °C has a coordination number of 8, and indium antimonide at 540 °C has a coordination number of 6. The present author proposes the following mechanism of changes on melting. At the moment of melting the structure is quite similar to that in the solid phase, the coordination number is low and the covalent bonds may be partially retained. Some of these bonds are responsible for properties described by Kontorova (Ref. 8), i.e. "orientation melting" takes place as a result of which hybridized  $sp^3$  bonds lose their definite directions in space and are able to rotate. Some oriented rigid bonds are retained and they are responsible for the initial low coordination numbers in liquids. The covalent bonds are destroyed on increase of temperature and new electron configurations appear which represent more symmetrical distributions of electron density in space and higher coordination numbers. On reaching their maximum value, coordination numbers are either constant or slightly reduced

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86702

S/180/60/000/006/020/030  
E111/E335

Characteristic Features of Changes in the Nature of Chemical Bonds and Structure of Semiconductors on Melting

by further increase of temperature and accompanying disordering processes. Thus, at high temperatures we have purely metallic structure with close packing. This hypothesis is tested by an analysis of the data on the fluidity (the reciprocal of kinematic viscosity) and free energy of activation of viscous flow; the latter is defined by

$$F_{\text{visc}} = RT \left( n(M\eta / Nh) \right),$$

where  $M$  is the molecular weight,  $\eta$  is the kinematic viscosity,  $N$  is the Avogadro number and  $h$  is the Planck constant. The results for gold and aluminium, which suffer

21X

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E111/E335

Characteristic Features of Changes in the Nature of Chemical  
Bonds and Structure of Semiconductors on Melting

small changes of structure on melting and no changes in the  
nature of bonds, and for bismuth and germanium (Fig. 2)  
confirm the author's proposed mechanism.  
There are 2 figures and 29 references: 17 Soviet and  
12 non-Soviet.

SUBMITTED: August 26, 1960

Card 4/4

S/032/60/026/06/15/044  
B010/B016

18.7520

AUTHORS: Glazov, V. M., Chizhevskaya, S. N.

TITLE: \ (Determination of Temperature at the Beginning of  
Crystallization of Alloys by Means of the Viscosity  
Method

PERIODICAL: Zavodskaya laboratoriya, 1960, Vol. 26, No. 6, pp. 720-723

TEXT: The applicability of viscosity measurement for determining the temperature of the beginning crystallization of alloys was investigated. The measurements were performed by means of a viscosimeter which was described in a paper by D. A. Petrov and V. M. Glazov (Ref. 6). The well-known system Sb-Ge (Ref. 5) was investigated at 600-900°C in the vacuum of  $10^{-3}$  torr. Instead of the kinematic viscosity the dependence of the logarithmic decrement ( $\delta$ ) of the deviations in the viscosity measurements on the temperature (Fig. 2) was determined. The physical behavior of the alloy when forming the first

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Determination of Temperature at the Beginning of Crystallization of Alloys by Means of the Viscosity Method

S/032/60/026/06/15/044  
B010/B016

crystals will thus be better illustrated. In the system mentioned the increase in viscosity on transition from the one-phase to the two-phase state was not so abrupt as was observed by Ye. G. Shvidkovskiy and L. S. Priss (Ref. 1) in Bi-Pb alloys. The liquidus line for the system  $\text{Sn-SiC}$  was drawn by the method described (Fig. 5). The dependence curves  $\delta$ ,  $t$  (Fig. 4) ( $t$  = temperature) show that  $\delta$  is much higher for the  $\text{Sn-SiC}$  alloys than for pure Sn. The dependence curves  $\delta$ ,  $t$  at different SiC content vary, which is due to a transition from the one-phase to the two-phase state. There are 5 figures and 6 references: 5 Soviet and 1 American.

ASSOCIATION: Institut metallurgii Akademii nauk SSSR  
( Institute of Metallurgy of the Academy of Sciences USSR )

Card 2/2

GLAZOV, V.M. (Moskva); LYU CHZHEN'-YUAN' [Liu Chén-yüan] (Moskva)

Kinetic characteristics of segregation microheterogeneity  
during the crystallization of solid solutions. Izv. AN  
SSSR. Otd. tekhn. nauk Met. i topl. no.2:99-107 Mr-Apr '61.  
(MTA 14:4)  
(Alloys--Metallography) (Crystallization)

12082

18 7530

1945, 1955, 1959

S/180/61/000/003/010/012  
E111/E152

AUTHORS: Glazov, V M.; Vertman, A A., and Shaidkovskiy, Ye. G.  
(Moscow)

TITLE: Contribution to the summary of a discussion on the  
structure and properties of liquid alloys

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh  
nauk, Metallurgiya i toplivo, 1961, No. 3, pp. 104-115

TEXT: This article relates to one which appeared in No. 6 of  
this journal, 1960. The authors state that a number of important  
questions remain to be clearly answered in the field of liquid-  
metal structures, particularly: 1) for which systems and to what  
extent does the nature of particle interaction forces change during  
transition from the solid to the liquid state; 2) how is liquid  
structure linked with that of the original crystal and to what  
temperature does the link persist; 3) what is the structural unit  
of various liquids; 4) can a model of liquid structure be found  
as universal as the crystal lattice for solids; 5) to what extent  
can properties of the crystallized material be influenced in a  
given way through the liquid. What is needed is a theory of  
Card 1/7



22982

Contribution to the summary of a ... S/180/61/000/003/010/012  
E111/E152

the liquid state embodying the molecular-kinetic theory of phase transition. In the present survey the authors set out to express some definite ideas on the required research programme. They have all made their own contributions (e.g. Ref. 10: Ye.G. Shvidkovskiy, N.N. Rakova, Tam Zhe. Ref. 12: V.M. Glazov, present journal, No. 6, 1960; Ref. 15: A.A. Verzman, A.M. Samarin, DAN SSSR, 1960, 134, No. 2). Basic ideas (Ref. 1: Ya.I. Frenkel', Sobraniye trudov, 3, Akademizdat, 1959; Ref. 2: N.N. Bogolyubov, Gostekhizdat, 1946; Ref. 3: I.Z. Fisher, Fizmatgiz, 1961), must be developed and extended. Diffraction methods (Ref. 14: T.A. Kontorova, present journal, 1961, No. 3) must be developed and supplemented by new methods. Molecular vapours of liquids could give indications of liquid structural units and crystallization, especially of supercooled liquids, should also be studied. A systematic study is needed of electrical properties, which shed light both on changes in inter-particle forces and in structure on crystallization and melting. An attempt to link the liquid coordination number and its change on heating with the electronic structure of the atom (Ref. 7: V.K. Grigorovich, Tam Zhe, 1960, No. 6) is an interesting supplement to earlier ideas which are in agreement with those of Card 2/7

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Contribution to the summary of a ... S/180/61/000/003/010/012  
E111/E152

Bernal (Ref.8; Scientific American, 1960, 203, No.2). The existence of directed inter-atomic bonds complicates the picture obtained. Three cases of liquid structure have been recognized (Ref.3; and Ref.9; I.Z. Fisher, present journal, 1960, No.6) in an approach based on the idea of disturbance of the "original lattice" by thermal vibrations. A study of crystallization of supercooled tin by electrical conductivity measurement indicates the absence of any simple and obvious link between the number of crystallization centres formed and the final distance (Ref.10). Fruitful results, e.g. for germanium (Ref.12) have been obtained from a method based on changes of structure-sensitive properties with temperature. "Oriented fusion" is another view of the mechanism of metallization of the bond on fusion of germanium and silicon (Ref.13; T.A. Kontorova, FTT, 1959, V.1, No.11, 1761. Ref.14). There is some evidence of increase in the coordination number of iron on heating (Ref.15) and the possibility of polymorphic transformations has been considered (Ref.16; Yu.A. Klyachko, present journal, 1960, No.6. Ref.17; S.S. Urazovskiy, Izd. AN Ukr.SSR, 1956. Ref.18; S.F. Khokhlov, present journal, 1960, No.6). An interesting approach is the comparison of experimentally determined heats of

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Contribution to the summary of a ..... <sup>22982</sup>  
S/180/61/000/003/010/012  
E111/E152

fusion of silicides with those calculated by an approximate equation for a type  $A_mB_n$  intermetallide (or from entropies of fusion) (Gel'd, P.V., Korshunov, V.A., and Petrushevskiy, M.S., Tam Zhe, Ref.19; Gel'd, P.V., and Kocherov, P.V., Tam Zhe, Ref.20). A "geometrical" approach to liquid structure based on structural crystallography has also been made (Ref.18). Fedorov's theory of space groups can be used in connection with the possibility of formation of quasi-compounds with a structure which in general has no analogues in the solid state (e.g. Refs. 21; M.I.Shakhparonov, Tam Zhe, 1961, No.3; Ref.5; O.Ya. Samoylov, Izd. AN SSSR, 1957; Ref.22; V.M. Glazov, S.N. Chizhevskaya, Tam Zhe, 1961, No.3). Mass spectroscopy of vapours and study of condensate structures has shown the possibility of polyatomic formation in the vapour (Ref.23; G.M. Martynkevich, Tam Zhe, 1960, No.6). At near-liquidus temperatures, the discussion showed, there is a close-order structure which is generally only qualitatively related to the phase diagram. For classifying liquids the energy of inter-particle interaction or some related value should be used. Deviations from ideal-solution laws are a possible index (Ref.24; Yesin, Yu.A., Sryvalin, I.T., Tam Zhe), as are composition versus Card 4/7

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Contribution to the summary of a ... S/180/61/000/003/010/012  
E111/E152

property curves. The latter has been used for a system of classification (Ref.25: F.Zauerval'd, Tam Zhe, 1961, No.3) which is only partially successful, and Kurnakov's system (Ref.26: N.S. Kurnakov, Izd. AN SSSR, 1940) is still useful. With a few exceptions (Ref.27: Yu.A. Nekhendzi, N.G. Girshovich, present journal, 1961, No.3, and Ref.28: A. Grbek, Tam Zhe) the participants in the discussion preferred isotherms to lines of equal superheat. The structure of liquid eutectics was widely discussed, three main points of view being apparent. The first, originated by Danilov (Ref.4: V.I. Danilov, Izd. AN Ukr. SSR, 1956), regards melts of eutectic composition as containing a more or less developed chemical microheterogeneity (Ref.29: A.S. Lashko, A.V. Romanova, Tam Zhe; Ref.30: V.M. Glazov, A.A. Vertman, Izd. AB SSSR, 1960), experimental confirmation is available (Ref.31: A.R. Regel', F. Gaybullayev, ZhTF, 1957, V.27, No.9; Ref.24). The average size of these eutectic colonies is considered to be  $10^3 \sim 10^4$  atoms (confirmed in Ref.33: A.A. Vertman, A.M. Samarin, A.M. Yakobson, Tam Zhe) and their composition close to that of the corresponding solid solution (Ref.32: G.M. Bartenev, present journal, 1961 No.3).

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Contribution to the summary of a .... S/180/61/000/003/010/012  
E111/E152

Another view (Ref.28) is based on that of Haveling (Geveling) that the liquid eutectic is a compound decomposing on crystallization. Chemical microheterogeneities, however, are not developed in all systems (Ref.30). Although the energy of mixing of liquid eutectics is almost always positive and thus favours the possibility of their development, this has been experimentally confirmed (e.g. Refs. 4, 29, 33 and 34; K.P. Bunin, Izv.AN SSSR, OTN, 1946, No.2). The view that negative deviations from ideality arise in all Me-Si systems (Ref.24) is incorrect. There was comparatively little discussion of the structure of chemical compounds in the liquid state. The only clear fact on this is that strong bonds in the solid state tend to persist into the liquid; this has much experimental support (Refs. 25, 26, and Ref.35; A. Roll, present journal, 1960 No.6; Ref.36; E. Gebhardt, M.Becker, Z.Metallkunde, 1955, 46, 90; 1955, 46, 669; Ref.37; D.K. Belashchenko, present journal, 1960 No.6; Ref.38; V.M.Glazov, Tam Zhe, 1960, No.5; Ref.39; A.A. Vertman, A.M. Samarin, Izd. AN SSSR, 1960; Ref.40; A.A. Vertman, V.M. Glazov, present journal, 1959, No.1). From experimental data (Ref.41; A.F. Skryshevskiy, Tam Zhe, 1960, No.6. Ref.42; V.M. Glazov, A.A. Vertman, DAN SSSR, Card 6/7

22982

Contribution to the summary of a ... S/180/61/000/003/010/012  
E111/E152

1958, V.123, No.3. Ref.43: V.M. Glazov, D.A. Petrov, DAN SSSR,  
1958, V.120, No.2. Ref.44: V.M. Glazov, D.A. Petrov, Izv. AN SSSR,  
OTN, 1958, No.4). Skryshevskiy concluded that chemical compounds  
melt without appreciable dissociation and remain fairly stable  
above the melting point. But this does not apply to Au-Sn  
(Ref.45: A.S. Lashko, DAN SSSR, 1959, V.125, No.1). Additional  
information is provided by surface-tension (Ref.19) and viscosity  
(Ref.46: V.N. Yermenko, V.I. Nizhenko, Yu.V. Naydich, present  
journal, 1961, No.3) data. Interaction between elements in  
ternary alloys was also considered (Ref.48: V.M. Glazov, Izv. AN  
SSSR, 1960). The discussion showed the need for a thorough study  
of composition - property relationships.  
There are 48 references: 46 Soviet, 1 German and 1 English.  
The English language reference reads as follows:  
Ref.8: J.D. Bernal, Scientific American, 1960, 203, No.2.

SUBMITTED: March 18 1961

Card 7/7

GLAZOV, V.M. (Moskva); CHIZHEVSKAYA, S.N. (Moskva)

Connection between the properties of certain semiconducting  
chemical compounds in solid and liquid states. Izv. AN. SSSR.  
Otd. tekhn. nauk. Met. i topl. no.3:154-157 My-Je '61. (MIRA 14:7)  
(Semiconductors)

GLAZOV, V.M. (Moskva)

Plotting the solidus curve by the method of measuring the  
microhardness. Izv. AN SSSR. Otd. tekhn. nauk. Met. i topl.  
no.4:39-42 J1-Ag '61. (MIRA 14:8)  
(Phase rule and equilibrium)  
(Hardness—Measurement)



28037

S/161/61/003/009/021/033  
B102/B104

24,7780 (1144, 1160, 1164)

AUTHORS: Glazov, V. L., and Chizhova, Zh. L.

TITLE: Study of the electric conductivity of germanium and of the  $A^{III}Sb$  compounds in the melting range and in the liquid phase

PERIODICAL: fizika tverdogo tela, v. 5, no. 3, 1963, 2503 - 2509

TEXT: The nature of the change of the chemical bonds in melting germanium and the  $A^{III}Sb$  compounds has hitherto been insufficiently studied and the conclusions drawn by different authors diverge. Thus, e.g., A. R. Regel assumed that on melting the three-dimensional system of the solid homeopolar bonds is destroyed. L. A. Kontorova observed that on melting not the nature of the bonds is changed but only the valence bridges loose their rigid spatial orientation. In a previous paper V. L. Glazov found that on melting the rigidly oriented bonds are often conserved and are destroyed only when the temperature is further increased. In this case new electron configurations are then formed. To give a definite explanation of these phenomena the authors measured the temperature dependence of the electric conductivity of Ge,  $AlSb$ , and  $GaSb$ , and  $InSb$  on melting and in the liquid phase. The Card 1/5

20037

S/121/41/103/004/021/037  
E102/E104

# Study of the electric conductivity

specimens were produced from single crystals; the total impurity concentration did not exceed  $10^{-4}$  -  $10^{-5}$ . The  $\sigma(t)$  curves of all specimens showed a similar course:  $\sigma$  was constant up to the melting point where it suddenly steeply rose to a multiple (3 - 5) of its value and after which it slightly decreased again. Only in InSb  $\sigma$  slightly increased already before the melting point was attained. As soon as the melting point was attained it increased jump-like and on further heating it decreased somewhat more rapidly than in the other semiconductors studied here. In all cases the sharp decrease of  $\sigma$  was observed approximately 10 - 20°C after the melting point was attained. The absolute values of  $\sigma$  of the molten semiconductors indicated a regular change in the sequence Ge - InSb - GaSb - AlSb. These results permit definite conclusions on the change of the bond character. As was assumed already by Regel<sup>1</sup>, the rigid homopolar bonds are destroyed on melting. This destruction is, however, incomplete. On further heating, the bonds were completely destroyed (which is proved by the further, although weak, increase of  $\sigma$  after the melting). For InSb this second stage is limited to a very narrow temperature range. This is due to the fact that InSb has a metallic bond character already in the solid phase. The assumption of the fundamental change of the bond character on melting was verified by measuring  $\sigma(t)$  on cooling. It was found that the  $\sigma(t)$  curves

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20007

S, 181/81, 004, 001, 002, 003  
1100, 1101

Study of the electric conductivity

are irreversible which proved the radical change of the band character  
There are 7 figures and 12 references: 11 Soviet and 1 non-Soviet

1100-1101: Institute of Metallurgy, Acad. A. A. Baykova, Ak. USSR Academy  
1101: Institute of Metallurgy, Acad. A. A. Baykova, Ak. USSR Academy

1101-1102: April 14, 1961

21339

S/078/61/006/004/012/018  
B107/B218

188200

1418

AUTHOR:

Glazov, V. M.

TITLE:

Reaction of germanium with gallium antimonide in the liquid phase

PERIODICAL: Zhurnal neorganicheskoy khimii, v. 6, no. 4, 1961, 933-936

TEXT: Two cuts of 50 and 75 atom% Ge from the system Ge - Ga - Sb (Fig. 1) were studied. The viscosity of the melt between 800 and 1200°C was measured to find out in what form the compound GaSb occurs in the melt. Besides, the investigation is of importance to the manufacture of alloyed germanium single crystals. Germanium with a maximum impurity of  $10^{-4}\%$ , gallium and antimony of a purity of no less than 99.99 % were used as starting materials. The viscosity of the melt was determined by filling the sample into cylindrical quartz ampoules which were then suspended on an elastic string, and the attenuation of oscillations was measured. The method is described in detail in Ref. 7 (Ye. G. Shvidkovskiy. Nekotoryye voprosy vyazkosti rasplavlennykh metallov. Gostekhteorizdat, M., 1955). The measurement of the two cuts is illustrated in Figs. 2 and 3.

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Reaction of germanium with gallium...

S/078/61/006/004/012/018  
B107/B218

from which the isothermal lines shown in Figs. 4 and 5 were determined. These lines exhibit a marked maximum of the quasibinary cut Ge - GaSb, which is rounded off with increasing temperature and is shifted to the side of higher antimony content. It may be concluded therefrom that GaSb partly dissociates in the melt, which process increases with a rise in temperature. As is shown by the isothermal lines of viscosity, this dissociation is stronger in melts containing 75 atom% of Ge than in those with only 50 atom% of Ge. Thus, GaSb behaves like a weak binary electrolyte at increasing dilution. If a germanium single crystal is drawn from such a melt, it will contain different quantities of Ga and Sb. It follows from a previous paper dealing with aluminum and indium antimonides (Ref. 2: V. M. Glazov, D. A. Petrov. Izv. AN SSSR, Otd. tekhn. n., no. 4, 125 (1958)) that the reaction between aluminum and antimony is in germanium solution stronger, while that between indium and antimony weaker than the reaction between gallium and antimony studied here. A. N. Mel'kumov, a student of MEI, took part in the experiments. There are 5 figures and 12 references: 11 Soviet-bloc. The reference to the English-language publication reads as follows: M. Hansen. Constitution of binary alloys, New York - Toronto - London, 1958.

Card 2/5

21.52

S/032/61/027/004/006/028  
B110/B215

26.2532  
AUTHORS:

Glazov, V. M. and Krestovnikov, A. N.

TITLE:

Examination of thermoelectric properties of substances in microvolumes

PERIODICAL: Zavodskaya laboratoriya, v. 27, no. 4, 1961, 416-419

TEXT: Physicochemical properties of individual phases or structural components have frequently to be determined for microscopic studies of metal structures. As early as in 1946, G. V. Akimov suggested a method of measuring the thermo-emf of individual phases. Fig. 1 shows a device combined with the optical system of the ПМТ-3 (PMT-3) apparatus for measuring the microthermo-emf at any place of the microsection surface. Needle (1) is housed within (2) and fixed in its position by two ebonite bushings (3) and screws (4). The heating element (7) is fed via rheostat  $R_1$ . The thermocouple (8) attached 3 - 4 mm above the needle tip measures the surface temperature. As soon as the needle tip touches the test specimen (9), a thermo-emf occurs which is determined by the

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H110/B215

Examination of thermoelectric...

properties of the microvolume touched by the needle. The deflection on the measuring scale is regulated by rheostat  $R_2$  and the temperature change of the needle tip. Relative values are obtained by reading the millimeter graduations on the scale. To obtain absolute values, however, it is necessary to graduate the apparatus. The latter is equipped with the respective needle and specimen which show a thermo-emf of a known quantity at a definite temperature. For this purpose, thermal calculation considering the parameters of needle and specimen, and exact temperature of the points of contact, are necessary:  $t = t_0 B / [BCh(mL) + Sh(m)]$ .

where  $B = m\lambda_c r_0 / 2\lambda_{specimen}$ ,  $t_0$  = temperature determined by thermocouple.  
 $m = \sqrt{2\alpha_c / \lambda_c r_0}$  (for needles of round cross section),  $\lambda_{specimen}$ ,  $\lambda_c$  = coefficients of thermal conductivity of specimen and needle. Temperature field, resistivity, and therefore also the amperage (measured by a galvanometer) of the point of contact depend on the surface of contact. With hard specimens and soft needles, the latter have to be blunted and loaded by weights of 5 - 10 g to obtain equal surfaces of contact in relative and absolute measurements. Alloys of germanium - silicon (20%)

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B110/B215

Examination of thermoelectric...

and bismuth - antimony (30%) obtained from chemically pure elements at  $10^{-4}$  mm Hg in sealed quartz phials were examined to study liquation heterogeneities. Microsections were etched with  $\text{HNO}_3$  (for Bi-Sb alloy), and a mixture of NaOH and  $\text{H}_2\text{O}_2$  (for Ge-Si). The microthermo-emf was measured in a section of 5-6 grains of a cross section  $\geq 1500 \mu$ . Fig. 2 (Curves 1 - 5) shows different values for center and boundaries of the grain. In Bi-Sb alloys, they are considerably smaller in the grain center, and in Ge-Si alloys somewhat larger than along the boundaries. These results are in good agreement with the concentration dependence of microthermo-emf. Water-cooled alloys show no microinhomogeneities and, therefore, no difference in microthermo-emf (Fig. 2, Curve 6). This had been experimentally proven before. The states of alloy additions in solid solutions cannot always be clearly determined by methods of electrical conductivity, X-ray structural analysis, and microhardness. For the purpose of studying chemical reactions among the components of ternary solid solutions, the system copper - chromium - zirconium was examined. The high solubility of chromium and zirconium in copper yields a quasi-binary system:  $\text{Cu-Cr}_2\text{Zr}$ . The assumption of formations of  $\text{Cr}_2\text{Zr}$

X

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B110/B215

Examination of thermoelectric...

molecules was also due to the deviation of increase in microhardness and additivity. A 99.2% alloy of Cu was homogenized at 1000°C. and quenched in water. The time of measuring was 20 sec. Fig. 3 shows mean values of 5 - 6 measurements. The minimum lies at the point of intersection of the section examined, and that of the quasi-binary system Cu-Cr<sub>2</sub>Zr. In contrast to thermo-emf, grain boundaries in microthermo-emf do not affect the determination. There are 3 figures and 10 references: 8 Soviet-bloc and 2 non-Soviet-bloc. The two references to English language publications read as follows: Ref. 6: F. D. Rosi, M. C. Steel, J. of appl. Phys., v. 29, no. 11 (1958); Ref. 9: R. B. Hill, H. J. Axon, D. Phil. J. Just of Metals, v. 83, 7 (1954/1955).

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov AS USSR).  
Institut tsvetnykh metallov im. M. I. Kalinina (Institute of Nonferrous Metals imeni M. I. Kalinin)

Card 4/7

GLAZOV, Vasilii Mikhaylovich; VIGDOROVICH, Vilenin Naumovich;  
KHROUSHCHEV, N.M., prof., doktor tekhn. nauk, retsenzent;  
NOVIKOV, I.I., dots., kand. tekhn. nauk, retsenzent;  
ARKHANGEL'SKAYA, M.S., red. izd-va; MIKHAYLOVA, V.V.,  
tekhn. red.

[Microhardness of metals] Mikrotverdest' metallov. Moskva,  
Gos. nauchno-tekhn.izd-vo lit-ry po chernoi i tsvetnoi metal-  
lurgii, 1962. 224 p. (MIRA 15:2)  
(Metals--Testing) (Hardness)

S/180/62/000/001/007/014  
E195/E363

16719

AUTHOR: Glazov, V.M. (Moscow)

TITLE: Chemical interaction between alloying components of liquid ternary alloys

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Metallurgiya i toplivo, no. 1, 1962, 89 - 92

TEXT: The object of the present investigation was to check the author's postulate that the intensity of chemical interaction between two components of a ternary solid solution should be at its maximum in that concentration range in which evidence could be found of such an interaction taking place in molten alloys. To this end, the concentration-dependence of viscosity of molten alloys of the Ge-Al-Sb and Si-Al-Sb systems was determined. The alloys studied belonged to sections at 60 and 90 at.% Ge of the Ge-Al-Sb system and at 80 at.% Si of the Si-Al-Sb system. The experimental alloys were prepared from Ge and Si containing less than  $10^{-4}\%$  impurities, and Sb and Al at least 99.99% pure. The viscosity of the molten alloys was

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determined from the attenuation rate of vibrations of a cylinder filled with the molten metal and suspended from an elastic wire. The actual values of kinetic viscosity  $\eta$  were calculated from formulae for low-viscosity liquids. The results are reproduced in Fig. 3, showing the viscosity isotherms for Ge-Al-Sb (diagrams a, b) and Si-Al-Sb (diagram B) alloys belonging to sections at 80% Ge (diagram a), 90% Ge (diagram b) and 60% Si (diagram B); the isotherm temperatures are indicated by regions included in the diagrams; in every case, the Al concentration increases from left to right and Sb concentration from right to left. The presence of sharp maxima on the viscosity isotherms of Ge-Al-Sb alloys at points corresponding to equal Al and Sb contents in the alloy was attributed to the presence of the intermetallic compound AlSb in the molten alloy, flattening of these maxima with increasing temperature being attributed to increased degree of dissociation of these compounds at high temperatures. The maxima of viscosity isotherms of Si-Al-Sb alloys were much less pronounced and were shifted towards the Si-Al side of the diagram. This effect was taken to indicate

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a higher degree of dissociation of AlSb in these alloys due to higher temperatures at which they become molten (the formation of AlSb in molten Si-Al-Sb alloys is indicated also by the fact that losses of Sb due to volatilization during melting of Si-bearing alloys decrease considerably in the presence of Al). Comparison of the viscosity isotherms with the concentration-dependence of the microhardness of the alloys studied provided an additional support for the author's contention that interaction between alloying components in the solid state implies the existence of similar interaction in the liquid state. There are 5 figures.

SUBMITTED: June 29, 1961

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S/180/62/000/002/006/018  
E021/E535

AUTHOR: Glazov, V.M. (Moscow)

TITLE: The influence of the rate of cooling on the solidification of bismuth-antimony alloys

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye tekhnicheskikh nauk. Metallurgiya i toplivo, no.2, 1962, 66-70

TEXT: The Bi-Sb system was chosen to study whether or not diffusion occurred during solidification. Alloys containing 20, 30 and 40% Sb were used. Impurity content in the initial materials was not greater than  $10^{-3}\%$ . They were melted and, after very slow cooling, held for 10 hours at temperatures between the solidus and liquidus lines. For control purposes one alloy was held at 350°C for 10 days. After holding at the various temperatures, solidification was at different rates of cooling: in the furnace, in air, in water, in liquid nitrogen and in a copper mould cooled to -183°C. The microstructures of the alloys were then examined and the distribution of micro-hardness across the crystallites was determined. The samples  
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were etched in a 15% aqueous solution of nitric acid. Micro-hardness measurements were also made, using a load of 10 g. The results showed that in all cases the process of solidification was completed by precipitation of practically pure bismuth. Bismuth was shown up as dark areas by etching. The microhardness of these areas was 10-12 kg/mm<sup>2</sup>. Thus, it was concluded that at cooling rates of up to 10<sup>5</sup> degree/min solidification occurred by diffusion. The microhardness of the centres of the crystals was the same as the alloy with a composition corresponding to the point on the solidus line at the holding temperature. There are 2 figures and 1 table.

SUBMITTED: September 18, 1961

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S/180/62/000/003/005/016  
E111/E152

AUTHORS: Glazov, V.M., Stepanova, M.V., and Chuprakova, M.V.  
(Moscow)

TITLE: Contribution to the problem of the reaction between  
dissolved components in ternary solid solutions

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Otdeleniye  
tekhnicheskikh nauk. Metallurgiya i toplivo.  
no.3, 1962, 58-62

TEXT: Anomalies observed in the Al-Mg-Si system (Ref.2:  
V.G. Kuznetsov, Ye.S. Makarov, DAN SSSR, 3, 1939, 23) prompted  
the authors to investigate in detail the micro-hardness and  
electrical conductivity of solid solutions in the systems Al-Mg-Si  
(I), Al-Mg-Ge (II), Cu-Cr-Zr (III) and Cu-Ni-Be (IV). (I) was  
chosen to supplement available data for ternary systems at high  
temperatures; (II) to elucidate the nature of the reaction  
between magnesium and germanium; and (III) and (IV) for the above  
reasons and because of their possible application as heat-  
resisting alloys with a high electrical conductivity. The sections  
with 99 and 99.5 at.% Al were studied in systems (I) and (II)

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respectively; those with 95.5 at.% Cu in (IV); and with 1 at.% Cu and 0.6 Zr in (III). Cast alloys were deformed and heat treated. Polished sections and conductivity test pieces were then prepared. The results indicate that there is chemical reaction between the alloying elements in ternary solid solutions which is especially marked when the ratio of alloying components corresponds to the appropriate compound. The nature of the property-composition diagrams obtained can be explained on the assumption that the chemical reaction leads to lattice disturbances localized at definite places, the distortion of the lattice as a whole being less than if the phenomenon was of totally random character. There are 4 figures.

SUBMITTED: January 2, 1962

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S/806/62/000/003/012/018

AUTHORS: Novikov, I.I., Glazov, V.M., Zolotarevskiy, V.S.

TITLE: Influence of the rate of cooling during crystallization on the chemical micrononuniformity of alloys.

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniye splavov tsvetnykh metallov. no.3. 1962, 136-142.

TEXT: The paper is based on the experimentally supported postulate that the chemical micrononuniformity of an alloy, resulting from crystallization in nonequilibrium conditions, is a function of the rate of freezing, and, moreover, that a number of peculiarities occur in the development of dendritic liquation in various ranges of freezing rates. It is reasoned that during the growth of a solid-solution crystallite enriched with one of the components, the melt layer adjacent to the phase interface becomes enriched with the other component. The existence of the concentration gradient leads to the process of equalizing diffusion in the liquid phase (EDL). Meanwhile a new layer of solid solution, having a composition that is at variance with the composition of the liquid phase, forms in immediate contact with the crystallite. This process may be tentatively named separating diffusion (SD). The SD produces an equilibrium difference of concentrations that is determined by the horizontal distance between liquidus and solidus on the phase diagram. Lastly, the presence of a concentration gradient within the crystallites gives rise to an equalizing diffusion within the solid phase (EDS). Obviously, these 3 elementary diffusion

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processes govern the character and degree of the chemical micrononuniformity in the course of nonequilibrium crystallization. Since dendritic liquation leads to the formation of a concentration gradient within the primary crystallites of the solid solution and also of a second structural component (e.g., the eutectic), two indices of chemical micrononuniformity of liquational origin must of necessity be distinguished, namely, a total liquational micrononuniformity due to the chemical-component-concentration difference between a second structural component and that existing in the crystallization center of the primary crystallites, and an intracrystalline liquation micrononuniformity between the component concentrations at the periphery and at the center of the primary crystallites. The effect of the freezing rate on these two indices is qualitatively analyzed, showing how an increasing rate of freezing does not permit the EDS to catch up with the difference in composition between the surficial region and the center of the dendritic grain. Beyond a certain freezing rate the composition of the center of the dendritic grain is invariably determined by the point on the equilibrium solidus and does not change with any further increase in freezing rate, until, at a still higher freezing rate, the SD in the liquid melt begins to be depressed, so that the composition of the center of the dendritic lattice begins to change back from the solidus value toward the initial melt concentration. Lastly, at a certain freezing rate, the SD in the liquid phase is wholly inhibited, and nondiffusional crystallization occurs, whereupon the composition of the uniform solid solution throughout the crystallite equals the concentration of the

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ANALYSIS OF THE ELECTRICAL PROPERTIES OF SILICON  
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PERIODICALLY

The electrical properties of the highest purity, single-crystal silicon have been studied as a function of conductivity of silicon during melting and in the liquid state. The viscosity and the electric conductivity of the melt at elevated temperatures were measured applying the method of forced oscillations and the rotating field, respectively. The electrical conductivity of the melt, measured at  $10^{-3}$  A/cm<sup>2</sup> current density, and resistance of the melt at  $10^{-3}$  A/cm<sup>2</sup> current density, used, the measurements were carried out in a vacuum of about  $10^{-5}$  mm Hg. A sudden very large increase in the electric conductivity was observed at the fusion temperature (1410-1460°C), which is attributed to a grain reconstruction of the non-crystalline surface in the principle of close packing; the maximum values are observed at the melt is over-heated by

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